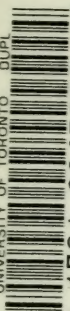


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Guide to the British fresh-
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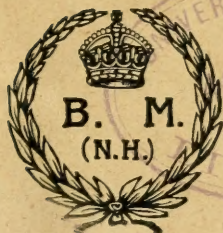
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GUIDE
TO THE
BRITISH FRESH-WATER FISHES

EXHIBITED IN THE
DEPARTMENT OF ZOOLOGY
BRITISH MUSEUM (NATURAL HISTORY),
CROMWELL ROAD, LONDON, S.W.

WITH TWENTY-THREE ILLUSTRATIONS



LONDON
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1917

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by C. Tate Regan

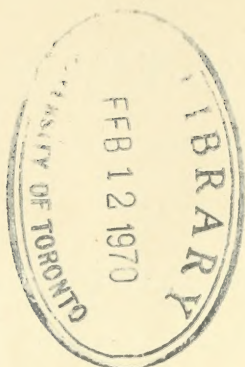
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PREFACE.

THE present Guide to the British Fresh-water Fishes has been written by Mr. C. Tate Regan, M.A., who has given much attention to the improvement of the exhibit during the last few years. The small collection to which it furnishes explanatory notes is exhibited at the extreme western end of the Bird Gallery, on the Ground Floor of the western wing of the building. The following pages contain particulars of the fishes exhibited, when these are of interest, and give a brief account of the characteristic features and distribution of each species, with an indication of the size that may be attained by individual specimens. Fuller information will be found in Mr. Regan's work, "British Fresh-water Fishes."* Most of the specimens are recent acquisitions, but some of them are old ones which have been re-modelled and re-painted. Several of the new specimens have been received as the result of an appeal to anglers for specimen fish, kindly inserted in "The Fishing Gazette" by the Editor, Mr. R. B. Marston.

The successful and artistic models of the Minnow, Stickleback and Gudgeon are the work of the donor, Mr. F. Page. Nearly all the rest of the exhibited specimens have been prepared by Mr. A. Fieldsend in the Museum. The series of photographs of scales are the work of Mr. J. A. Milne, who presented them.

In addition to the above, the thanks of the Trustees are due to Messrs. J. Andrews, F. Barker, F. R. Graham, J. A. Hutton, E. Kempsey, W. E. Park, and A. P. Zerfass, for gifts of specimens which have been used in the preparation of the exhibition.

SIDNEY F. HARMER,
Keeper of Zoology.

BRITISH MUSEUM (NATURAL HISTORY),
CROMWELL ROAD, LONDON, S.W.

January 29th, 1917.

* London, Methuen and Co., 1911, price 6s.



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BRITISH FRESH-WATER FISHES.

INTRODUCTION.

THE British Fresh-water Fishes are exhibited in the British Saloon at the far end of the Bird Gallery. On entering the Saloon from the Bird Gallery the visitor turns sharply to the right and finds the fishes facing him, occupying two adjacent wall-cases. In the limited space available it has been impossible to adhere strictly to a systematic arrangement, but the general plan is that the Sturgeon and the Salmonoids occupy the case on the right and the Cyprinoids that on the left; the other families, which together include but a small proportion of the species, are placed above, below and to the left of the Cyprinoids. Each specimen exhibited is provided with a number, and these numbers are repeated in the Guide.

Many of our fresh-water fishes spend part of their life in the sea: some of these, such as the Stickleback, both feed and breed in either fresh or salt water; others, like the Salmon, feed in the sea and breed in the rivers, whilst the Eel, on the contrary, descends to the sea to breed. Marine fishes that ascend rivers may form permanent fresh-water colonies, and in time these may become distinct races or even species. All the fresh-water fishes peculiar to the British Isles, such as the Char and Whitefish of different lakes, and the Killarney Shad, are closely related to marine fishes that spawn in fresh water. On the other hand, our Perch, Pike, Roach, Bream, etc., are true fresh-water fishes; they and their relatives are found only in fresh water. All our fishes of this type are found also on the continent of Europe, and as they cannot cross the sea it is evident that they reached our islands at a time when the latter were joined to the continent and our eastern rivers were, in all probability, tributaries of the Rhine.

The accompanying figures of the Perch and Trout (fig. 1) are intended to illustrate some of the differences used in characterising the families. In the Trout the maxillary bones form part of the upper border of the mouth, but in the Perch the premaxillaries exclude them from the oral margin. In the Trout the pelvic fins are abdominal, far behind the pectorals; in the Perch they are

thoracic, below the pectorals. In the Trout all the fin-rays are flexible, jointed and branched; in the Perch some of the rays are stiff pointed spines.

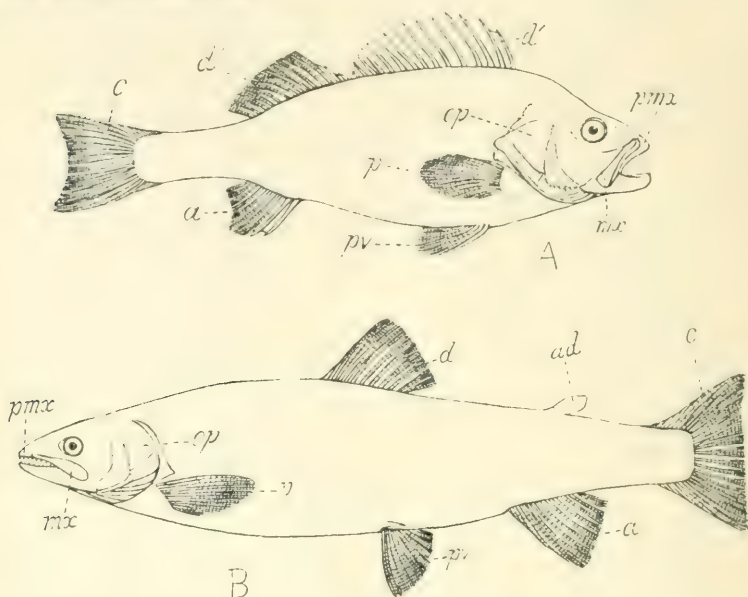


FIG. 1.—DIAGRAMMATIC FIGURES OF PERCH (A) AND TROUT (B).

pmx, praemaxillary; *mx*, maxillary; *op*, operculum; *d*, dorsal fin; *d'*, spinous dorsal fin; *d''*, soft dorsal fin; *ad*, adipose fin; *e*, caudal fin; *a*, anal fin; *pv*, pelvic fin; *p*, pectoral fin.

PETROMYZONIDAE.

This family includes about twenty species from the coasts and rivers of all temperate regions: some of these feed in the sea, but all breed in fresh water.

The Lampreys resemble Eels in form, but differ from them widely in structure: the most notable external differences from other fishes are that the mouth is surrounded by an expanded circular lip, the suctorial disc, which bears horny teeth, and that there is a series of seven small gill-openings on each side. There are no jaws, but there is a very muscular protrusible tongue, also furnished with horny teeth.

Lampreys attach themselves by means of the suctorial disc to other fishes and devour them, sucking the blood and scraping off

the flesh. They breed in the spring or early summer, when they make a sort of nest by clearing the stones away from a circular or oval space; the eggs are shed in the sand at the bottom of the

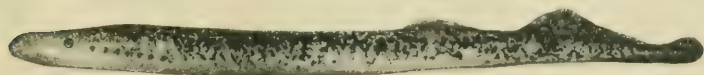


FIG. 2. SEA LAMPREY.

nest and develop into a larva (*Ammocoetes*), which has neither suctorial disc nor teeth, and lives in the sand like a worm; these larvae are called Prides. After three or four years of larval life, when the Prides are 4 to 6 inches long, the metamorphosis into the adult form takes place.

1. **Sea Lamprey, *Petromyzon marinus*** (fig. 2).—This species has the suctorial disc completely covered with series of teeth (fig. 3A); its marbled or spotted coloration is also distinctive. It

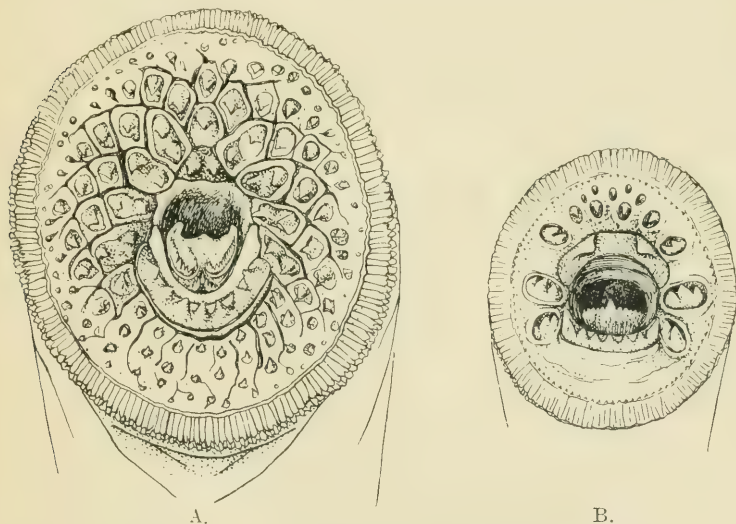


FIG. 3.—MOUTH AND SUCTORIAL DISC OF (A) SEA LAMPREY AND (B) LAMPFERN.

attains a length of 3 feet and a weight of 5 lbs. or more. It occurs on both sides of the North Atlantic and in the Mediterranean, preying upon Cod, Mackerel, etc. In the spring or summer the

sexually mature individuals migrate into the rivers to spawn, after which they die. The specimen exhibited, 34 inches long, is from the Severn.

2. Lampern or River Lamprey, *Lampetra fluviatilis*.—This is placed in a genus distinct from that of the Sea Lamprey on account of differences in the dentition of the disc and tongue (fig. 3). It is not spotted or marbled, and does not grow to a length of more than 16 inches. It inhabits the coasts and rivers of Europe, Northern Asia and Western North America; it resembles the Sea Lamprey in habits, but is more abundant. In some rivers, such as the Trent, a considerable proportion of the Lamperns do not migrate to the sea after metamorphosis, but pass their whole life in fresh water.

3. Brook Lamprey or Planer's Lamprey, *Lampetra planeri*.

This is very similar to the preceding species, but it has blunter teeth, and the edges of the disc are more strongly fringed; the dorsal fins are continuous, whereas in the Lampern they are separated by an interspace. This species ranges from Europe through Northern Asia to Japan; it is found in small streams and ditches, never goes to the sea, and grows but little, if at all, after the metamorphosis, reaching a length of only 6 or 7 inches.

ACIPENSERIDÆ.

This family inhabits the seas and rivers of Europe, Asia and North America. The produced snout, with a transverse series of four barbels in front of the small protractile mouth, the longitudinal rows of bony plates on the body, and the upturned tail are characteristic.

4. Sturgeon, *Acipenser sturio* (fig. 4).—The Sturgeon occurs on the coasts of eastern North America and of Europe from

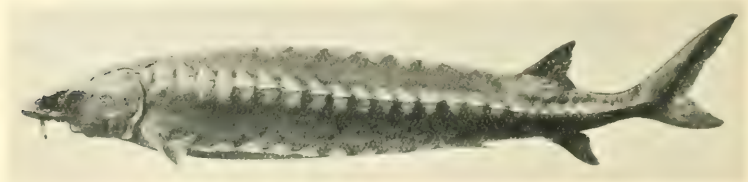


FIG. 4.—STURGEON.

Scandinavia to the Black Sea; it ascends rivers to spawn, but those that enter British rivers may be regarded as stragglers, as

it is doubtful if this fish breeds in our waters. It attains a length of 18 feet. It feeds on small invertebrates, stirring up the sand or mud with its snout and feeling for them with its barbels. A specimen 6 feet long is exhibited; it was taken in the Thames before 1855, in which year it was presented by the Zoological Society.

SALMONIDAE.

The Salmonidae are soft-rayed fishes with the pelvic fins far behind the pectorals, and with the non-protractile mouth bordered above by the praemaxillaries in the middle and the maxillaries at the sides; they are distinguished from other British fresh-water fishes, except the closely related Osmeridae, by the presence of an adipose fin—a small fleshy rayless fin placed on the hinder part of the back. These features are illustrated in the diagrammatic figure of a Trout on p. 8 (fig. 1B). This is a northern family; many of the species are marine, but ascend rivers to breed; others are permanently established in lakes or rivers. The British Salmonidae belong to four genera, which may be shortly characterized as follows:—

1. *Salmo* (Salmon and Trout).—Mouth rather large; a double or zig-zag series of teeth along the vomer (in the middle of the roof of the mouth) present, at least in the young; dorsal fin relatively short, of 10 to 16 rays.
2. *Salvelinus* (Char).—Differs from *Salmo* in that vomerine teeth are present only as a group at the anterior end of the bone, which is raised and has a boat-shaped depression behind it.
3. *Coregonus* (Powan, Vendace, etc.).—Differs from *Salmo* in having the mouth small, without or with minute teeth.
4. *Thymallus* (Grayling).—Mouth small; dorsal fin long, of 18 to 24 rays.

5—12. Salmon, *Salmo salar*.—This important fish is too well known to need much description, but it is very closely related to the Trout, and it is not always easy to distinguish between them. In the Salmon the dorsal fin usually has more branched rays (10 to 12) than in the Trout (8 to 10), the scales on the tail number 10 to 13 in an oblique series from the adipose fin to the lateral line (13 to 16 in the Trout), the maxillary is shorter, even in large fish not extending far beyond the eye, and the tail is more constricted at the base of the caudal fin, which is more

emarginate than in Trout of the same size, although in old fish it may be truncate.

The Salmon is found on both sides of the North Atlantic, ranging from Hudson Bay, Greenland, Iceland and Northern Europe to Cape Cod and the Bay of Biscay. The size attained varies according to locality; a fish of 84 lbs. has been recorded from the Tay. Salmon feed on Herrings, Mackerel, Sand-eels, etc., and ascend rivers only for breeding purposes. Spawning takes place in the autumn or winter, the female fish scooping out a trough in which she deposits the eggs and then covers them



From a photograph

(by J. A. Hutton, Esq.)

FIG. 5.—SALMON PARR (lower figure) and YOUNG TROUT (upper figure).
Note the shorter maxillary, fewer spots, more slender tail and more deeply notched caudal fin of the Salmon.

with gravel. The young fish live in fresh water and are known as Parr (fig. 5). When they are about 6 inches long and usually two years old the Parr lose the large bluish spots or bars on the sides called Parr-marks, become very silvery, and are now termed Smolts. The Smolts migrate to the sea, usually in May, and grow very rapidly; they may return to fresh water after about a year in the sea as Grilse, weighing from $1\frac{1}{2}$ to 10 lbs., or may defer their return until they have spent two winters in the sea. Such fish, running up in the spring, are known as "Small Spring Salmon." But Salmon may pass several years in the sea and attain a large size before entering fresh water to breed. It

seems that Salmon seldom live longer than ten years or spawn more than three or four times; many spawn only once. After spawning the Salmon is termed a Kelt.

Enlarged photographs of scales of Salmonidae, presented by J. A. Milne, Esq., are exhibited in a frame on the wall to the

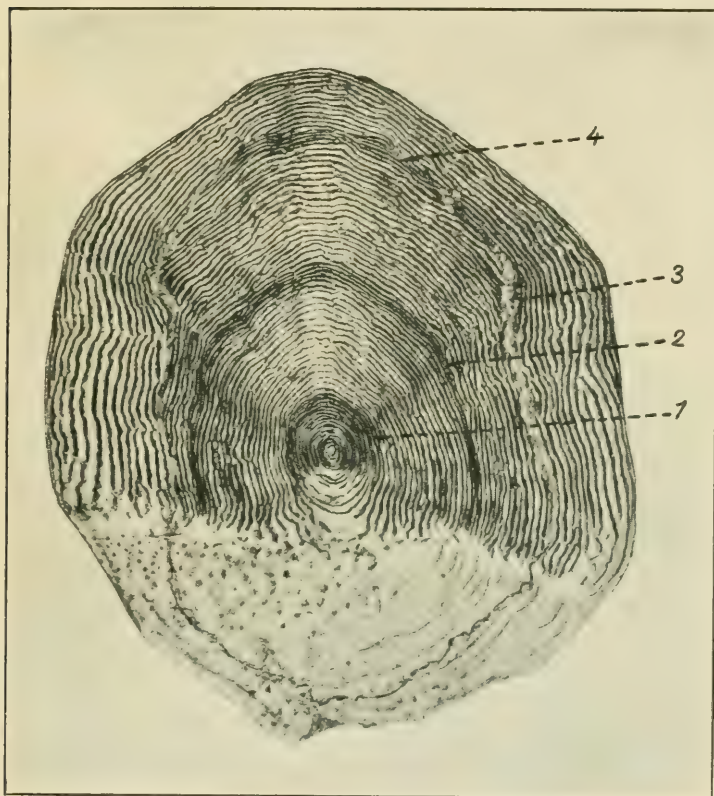


FIG. 6.—SCALE OF SALMON.

1 marks the edge of the Smolt scale; 2 indicates the first winter zone formed in the sea; 3 the spawning mark; and 4 the second winter zone formed in the sea, which has been obliterated, except anteriorly.

right. Nos. 1 to 7 are scales of Salmon, and illustrate how the age and life-history of the fish can be read on the scales. One of these photographs is reproduced here (fig. 6). The scales of a Salmon show concentric rings; as the fish grows the scales increase in size and more rings are added. In the summer,

when growth is rapid, numerous complete rings separated by relatively wide interspaces are formed: in winter, when growth is slower, the rings are fewer, incomplete and closer together: thus broad summer zones and narrower and darker winter zones are marked on the scales. The rings formed during the Parr stage are much closer together than those formed in the sea. When the Salmon enters fresh water to breed growth ceases and the edges of the scales become worn and irregular; if the Kelt gets back to the sea and resumes feeding new ridges are added outside this irregular edge, which then appears as a "spawning mark."

The specimens exhibited are a Parr (5) and a Smolt (6), each about 6½ inches long: a Grilse (7) of 4½ lbs. from the River Moy, Ballina, Ireland, taken in June, 1912; male (9) and female (8) Small Spring Salmon, 8 to 9 lbs., also from the Moy, taken in April, 1912 (in the male the snout is longer than in the female); a female Kelt (10) from the Wye, February 8, 1914, presented by J. A. Hutton, Esq. (a lean and dull-coloured fish); a female Salmon (11), 46 inches long and weighing 44¾ lbs., taken in the Wye on April 7, 1912, by the donor, J. A. Hutton, Esq. (like the Grilse and Small Spring Salmon this is a fresh-run fish, silvery and well proportioned); and a male Salmon (12), 55½ lbs., from the Tay, Sept. 28, 1898 (the produced jaws, curved at the tip, are characteristic of large males).

13 19. Trout, *Salmo trutta* (fig. 5). In the sea the Trout ranges from Iceland and Northern Europe to the Bay of Biscay, and as a fresh-water fish it extends to Southern Europe and even to Sardinia, Algeria and Morocco. Trout very similar to ours inhabit the Black, Caspian and Aral Seas and their tributaries. In our islands the Trout is found all round the coast, and in most lakes and rivers; it varies greatly in size, appearance, and habits. In some brooks and tarns it averages only 3 or 4 ounces, but in large lakes, such as Lough Neagh, it is said to grow to 50 lbs., and the Sea Trout of the Tweed and Coquet also attain a large size. Many Trout never go to sea; those that do may descend as smolts when about the same size as Salmon smolts, but they do not go so far out to sea as the Salmon, and often frequent the estuaries. Trout, unlike most Salmon, appear to be annual spawners.

The specimens exhibited illustrate to some extent the variation in size and colour. They are: (13) Sea Trout, 8 lbs. 4 oz., Montrose, July, 1901; (14) Great Lake Trout, the so-called "*Salmo*

ferox," length 35 inches, estimated weight 18 lbs., Loch Awe, 1906, presented by Major H. Maclean; (15) Loch Leven Trout, Loch Leven; (16) Gillaroo Trout, 5 lbs. 1½ oz., Lough Arrow, presented by J. Gunning, Esq.; (17–19) Trout from three Sutherlandshire lochs, Scourie, Borollan and Crocach.

Attention may be called to specimens illustrating the difference between our Trout (*S. trutta*) and the Californian Rainbow Trout (*S. irideus*); these are in table-case 43 in the Fish Gallery.

20—27. Char, *Salvelinus*.—Char are very similar to Trout, but they have smaller scales and there are no black spots; pink or orange spots are usually present, and the lower part of the fish is often of the same colour, or, in the breeding season, even crimson. Char are found in numerous lakes of Ireland, Scotland, the Lake District and North Wales, and of Scandinavia and the Alps. The Char (*Salvelinus alpinus*) of the Arctic Ocean ascends rivers to spawn, and does not range southwards as a marine fish beyond Hudson Bay, Iceland, Helgeland in Norway and the Kurile Islands. It is evident that the British and Irish Char are lacustrine colonies of the northern Char, which must have ascended our rivers when our seas were colder. The Char found in our lakes differ from *Salvelinus alpinus* and from each other, and may be regarded either as sub-species of *S. alpinus* or as so many separate species; fifteen have been recognized as distinct and have received specific names.

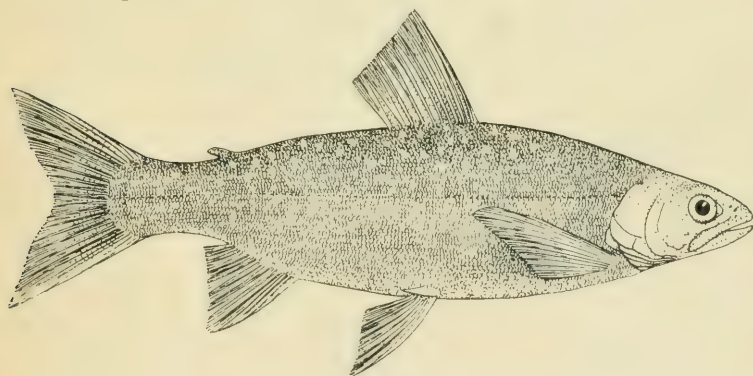


FIG. 7.—LOUGH MELVIN CHAR.

The exhibited specimens are: (20) *S. grayi* (fig. 7), from Lough Melvin, distinguished by its deep body, few scales and large fins; (21) *Salvelinus gracillimus*, from the Shetlands, notable for its

slender form; (22, 23) *S. willughbii*, the Windermere Char; (24, 25) *S. maxillaris*, from Ben Hope, Sutherlandshire, remarkable for the large mouth and strong jaws; and (26, 27) *S. killinensis*, from Loch Killin, Inverness-shire, a Char with blunt snout and subterminal mouth, large fins and very small scales.

Whitefish, *Coregonus*.—These fishes differ from Salmon, Trout and Char in their smaller mouth, with the teeth minute or absent, and in their larger scales. They have the general appearance of Herrings, but are distinguished by the presence of an adipose fin. They feed on minute crustacea, insect larvae, etc. Our species may be distinguished thus:—

Mouth terminal; lower jaw projecting . *Coregonus vandesius*.

Mouth terminal; jaws equal in front . *C. pollan*.

Mouth subterminal; lower jaw the
shorter; snout truncated . . . *C. clupeoides*.

Mouth inferior; snout produced . . . *C. oxyrhynchus*.

28. Vendace, *Coregonus vandesius* (fig. 8).—This little fish inhabits two lochs at Lochmaben, in Dumfriesshire, and is repre-

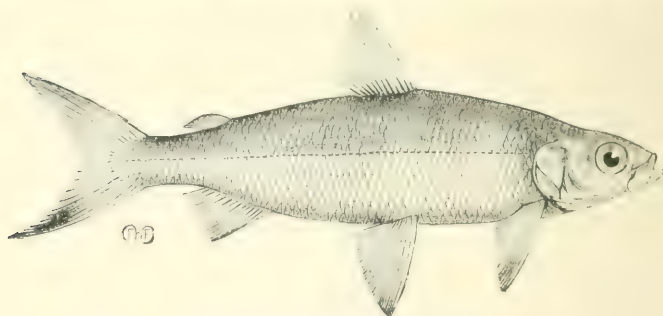


FIG. 8.—LOCHMABEN VENDACE.

sented in Derwentwater and Bassenthwaite Lakes by a distinct sub-species, *Coregonus vandesius gracilior*, which differs from the typical form in having the body more slender, the fins smaller and the dorsal rays more numerous. Vendace are never more than 9 inches long. Species related to the Vendace inhabit the countries round the Baltic, and others ascend Siberian rivers from the Arctic Ocean.

29. Pollan, *Coregonus pollan*.—This species is abundant in Lough Neagh, where it is regularly netted for the market. The

Lough Erne Pollan (*C. pollan altior*) and the Shannon Pollan (*C. pollan elegans*) (fig. 9) differ slightly from the typical form found in Lough Neagh. Pollan are usually 8 to 12 inches long,

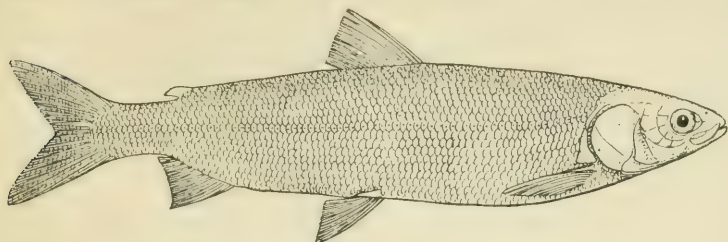


FIG. 9.—SHANNON POLLAN.

but sometimes measure 18 inches. An arctic marine species that ascends the rivers of Siberia is the nearest relative of this exclusively Irish fish.

30. Powan, *Coregonus clupeoides* (fig. 10B).—The Powan of Lochs Lomond and Esk, the Schelly (*C. clupeoides stigmaticus*) of Ullswater and Haweswater, and the Gwyniad (*C. clupeoides pennanti*) of Bala Lake, are all forms of a species that is represented in Scandinavia and Central Europe by a number of very similar species or sub-species, including the Blaufelchen (*C. wartmanni*)

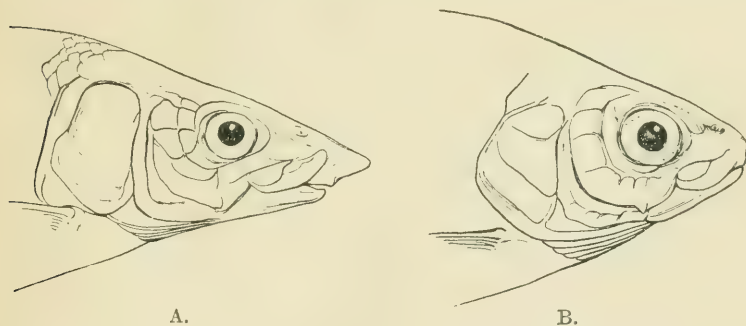


FIG. 10.—HEADS OF (A) HOUTING AND (B) SCHELLY.

of the Lake of Constance. *Coregonus muksun*, a migratory arctic species, is also closely related. The Powan is of the same size as the Pollan.

Houting, *Coregonus oxyrhynchus* (fig. 10A).—This is a migratory species of the coast of Europe from Scandinavia to Holland ;

occasional specimens cross the North Sea and have been captured in our eastern rivers.

31. Grayling, *Thymallus thymallus*. The Grayling is distinguished by the rather long dorsal fin, with the rays more numerous than in other Salmonoids. In scaling and size of the mouth it resembles the Whitefish more than the Salmon or Trout, but the teeth, although small, are quite distinct. The Grayling inhabits rivers of Northern Europe and of the Alps: in England and Wales it is rather local; it has been introduced into Scotland, but is absent from Ireland. Other species of Grayling are found in Siberia and in North America. In this country a Grayling of 5 lbs. is exceptional, but in northern Scandinavia they grow to more than twice that weight. The food consists of flies, insect larvae, small molluscs and crustaceans, etc. The breeding season is from March to May, later than in other Salmonidae. The fish exhibited is from the Test at Stockbridge; weight, 2 lbs. 12 oz.: presented by E. J. Power, Esq.

OSMERIDAE.

This family resembles the Salmonidae in external features, but differs in some important structural characters. Like the Salmonidae, it comprises northern marine fishes that breed in fresh water.

32. Smelt, *Osmerus eperlanus*. The Smelt is distinguished by its thin transparent scales and by its coloration. The translucent olive-green hue of the back is sharply defined from the bright silvery colour of the sides. The Smelt ranges from the Baltic southwards on our east and south-east coast to Hampshire, and on the west coast to North Wales. In the spring the shoals enter rivers to spawn; the eggs are not buried as in the Salmonidae, but lie on the bottom, adhering to the stones, etc., on which they fall. After spawning, the fish may stay in fresh water, sometimes remaining until the autumn; in Rostherne Mere, in Cheshire, the Smelt is a permanent resident. This fish feeds on small fishes, crustaceans, worms, etc.; it grows to a length of 13 inches.

CLUPEIDAE.

This important family inhabits the seas of all parts of the world; many of the species ascend rivers to breed, and a few are permanent residents in fresh water. The Clupeidae are similar to

the Salmonidae in most external features, but differ in the absence of the adipose fin. Of our British species, the Shads differ from the Herring, Sprat and Pilehard structurally in that the upper jaw has a well-marked median notch, and biologically in that they ascend rivers, especially the Shannon and the Severn, from April to June, to spawn in fresh water. The eggs lie at the bottom of the river, and the young fish migrate to the sea when they are two years old and about 6 inches long.

33. Allis Shad, *Alosa alosa*. This species is especially distinguished by the long and slender gill-rakers, numbering 55 to 85 on the lower part of the anterior branchial arch (fig. 12B). It reaches a weight of 8 lbs. The specimen exhibited, 24 inches long, is from the Severn at Gloucester.



FIG. 11.—TWAITE SHAD.

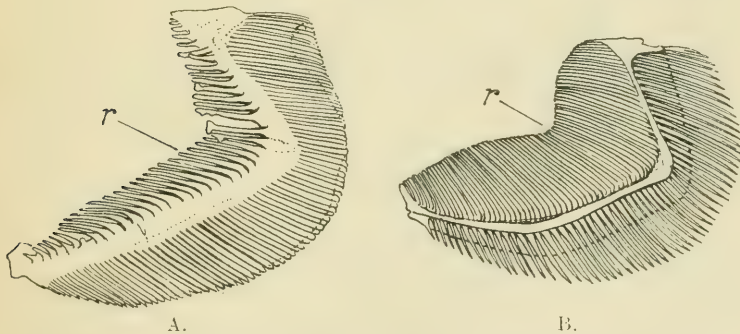


FIG. 12 —ANTERIOR BRANCHIAL ARCH OF (A) TWAITE SHAD AND (B) ALLIS SHAD.

r, gill-rakers.

34. Twaite Shad, *Alosa finta* (fig. 11).—The Twaite Shad has the gill-rakers much shorter and fewer than in the Allis Shad, numbering only 24 to 27 on the lower part of the anterior branchial arch (fig. 12A). It attains a length of 20 inches and

a weight of 4 lbs. The example exhibited, taken from the Severn at Worcester, was presented by C. H. Cook, Esq.

Killarney Shad, *Alosa jinta killarneyensis*. This interesting but little-known form is a permanent resident in the Lakes of Killarney. It differs from the migratory Twaite Shad in the deeper body and the more numerous gill-rakers; the latter number 30 to 33 on the lower part of the anterior branchial arch. The largest specimen as yet recorded is only 8 inches long.

ESOCIDAE.

This family differs from the Salmonidae and Clupeidae in the posterior position of the dorsal fin, which is above the anal; there is no adipose fin. It includes the single genus *Esox*, with six species in Europe, Northern Asia and North America.

35. Pike, *Esox lucius*.—This fish is so well known as to need no description; but it may be noted that the strong erect fixed teeth of the lower jaw are adapted for holding its prey, and that the bands of slender depressible teeth on the tongue and on the roof of the mouth help its passage inwards. The Pike is found all over Europe, except Spain and Portugal; it ranges through Russian Turkestan, Siberia and Mongolia, and in North America from Alaska to the Great Lakes; in the British Isles it is generally distributed, but becomes local in Northern Scotland. A weight of 40 lbs. is rarely exceeded in this country, but there seems little reason to doubt that a Pike of 52 lbs. was taken when Whittlesea Mere was drained in 1851, or that a still larger one was taken about 1775 in Loch Ken. The Pike is solitary, and feeds on other fishes; in the winter they pair, and in the early spring they make their way into ditches, backwaters, etc., and spawn among the weeds. The specimen exhibited, from Lough Arrow, was presented by Messrs. Williams and Son in 1907. It measures 46 inches in length, and probably weighed about 35 lbs. Another fine Irish Pike, 30 lbs. in weight, from Lough Conn, is shown in the Fish Gallery (Case 10, No. 407).

ANGUILLIDAE.

The Eels are recognized by the long, subcylindrical body, the terminal mouth, with bands of pointed teeth, the small gill-openings, the absence of pelvic fins, and the long dorsal and anal fins extending to the end of the tail. The family Anguillidae includes the genus *Anguilla*, with several Indo-Pacific species and

two from the Atlantic, of which the American Eel ranges from Greenland to the Antilles.

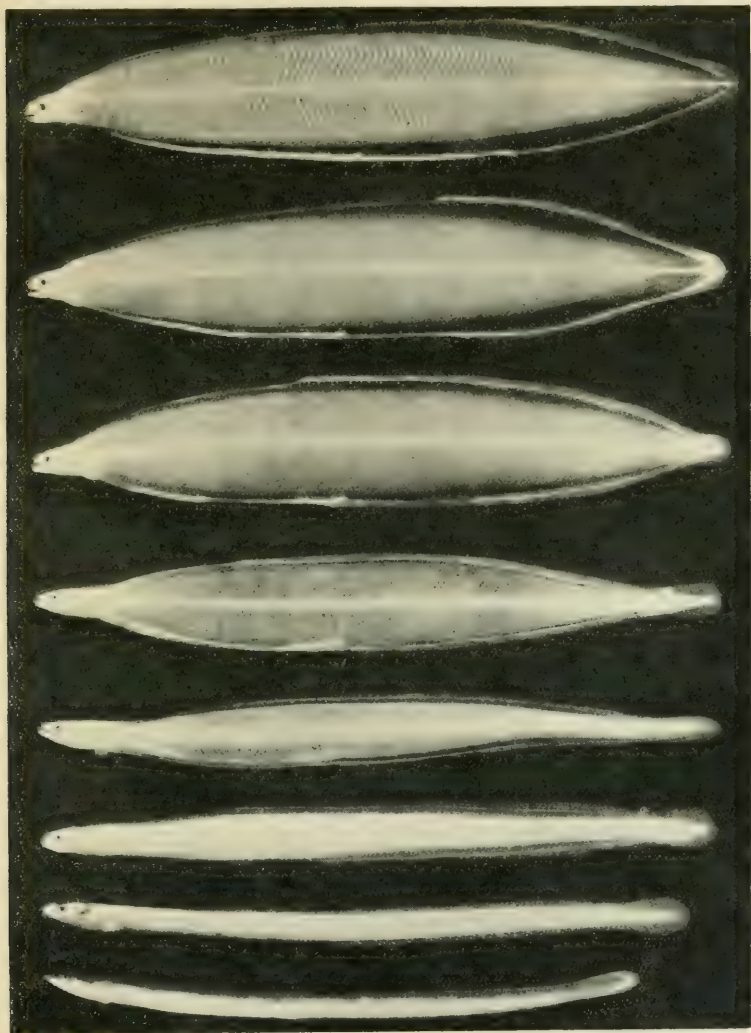


FIG. 13.—METAMORPHOSIS OF EEL, FROM LEPTOCEPHALUS TO ELVER.

(After Johs. Schmidt.)

36. Eel, *Anguilla anguilla*.—This species ranges from Iceland and Scandinavia to the Azores and Morocco; it inhabits the

Mediterranean but not the Black Sea. Eels occur in both fresh and salt water, in the former penetrating to the smallest brooks and ponds, in the latter lurking among rocks and weeds near the shore. They are almost omnivorous, but feed chiefly on small fishes, crayfishes, worms, etc.; they are nocturnal, in the day usually hiding in holes or lying buried in sand. Male Eels rarely grow to more than 20 inches long, but females grow much larger, especially in the fen district, where a length of over 5 feet and a weight of 20 lbs. or more may be reached. It is now established that the Eel breeds only once in its life. Towards the autumn a certain number become silvery and migrate to the sea and make their way far out into the Atlantic; their breeding place is in deep water, probably south of the Azores. The transparent strongly compressed larvae (*Leptocephalus*) are quite unlike the adult; when about 3 inches long they cease feeding, and during their migration towards the coasts and rivers, which occupies several months, they shrink both in depth and length, until they become little Eels, or Elvers, about $2\frac{1}{2}$ inches long (fig. 13). A series illustrating the metamorphosis of the Eel is exhibited in the case entitled "Fisheries Investigations" on the left of the staircase in the Central Hall. The Eel exhibited is from the Thames at Teddington: it measures 35 inches, and may have weighed from 4 to 5 lbs.

CYPRINIDAE.

This large family of strictly fresh-water fishes inhabits Europe, Asia, Africa and North America. All or most of the fin-rays are

flexible and jointed, and the pelvic fins are abdominal in position; there is no adipose fin; the mouth is toothless, protractile, and bordered above by the premaxillaries only.



FIG. 14.—PHARYNGEALS OF CHUB.

The pharyngeal bones, a pair of bones that lie in the throat just behind the gills, bear a small number of teeth that bite upwards against a hard plate supported by a process from the skull. In a wall-frame are exhibited the pharyngeals of some British species,

to illustrate the differences in the form, number and arrangement of the teeth.

1. Carp, *Cyprinus carpio* : teeth molariform, triserial, **1.1.3**
3.1.1.*
2. Crucian Carp, *Carassius carassius* : teeth compressed, uniserial, **4-4.**
3. Tench, *Tinca tinca* ; teeth wedge-shaped, uniserial, **5-4.**
4. Barbel, *Barbus barbus* ; teeth subconical, hooked, triserial, **2.3.5-5.3.2.**
5. Chub, *Leuciscus cephalus* (fig. 14) ; teeth subconical, hooked, biserial, **2.5-5.2.**
6. Rudd, *Scardinius erythrophthalmus* ; teeth compressed, with pectinated (comb-like) edges, biserial, **3.5-5.3.**
7. Roach, *Rutilus rutilus* ; teeth conical or slightly compressed, not pectinated, uniserial, **5-6.**
8. Bream, *Abramis brama* ; teeth compressed, notched, uniserial, **5-5.**

Enlarged photographs of the scales of Cyprinidae (Roach, Gudgeon, Barbel, Chub and Tench) and of some other British



FIG. 15.—SCALE OF RUDD.

* The formula 1.1.3-3.1.1 indicates that on each side there is one tooth in the outer series, one in the next, and three in the inner series. The number of teeth is not always the same on both sides ; 5-4 (Tench) means 5 on one side and 4 on the other.

fresh-water fishes, presented by J. A. Milne, Esq., are shown in a frame below that illustrating the scales of the Salmonidae. The Cyprinoid scales differ in detail, but all show concentric ridges and radiating grooves (fig. 15), as do the scales of the Pleurocentridae and Percidae; in the last named the free edge of the scale is studded with little denticles; in the Salmonidae and Gadidae the grooves are absent; and in the Clupeidae both ridges and grooves tend to become transverse.

The British Cyprinoids are more or less gregarious, and in the spring or early summer, when they breed, they crowd together on the shallows. The majority are found in lakes or ponds as well as in rivers, but some, such as Carp, Tench, Rudd and Bream, prefer still or slow-running water, whilst others, such as the Dace, frequent the swifter streams. They feed on a mixed diet of weeds, insect larvae, small crustacea, insects, etc., and the Chub may even eat small fishes.

The British Cyprinidae may be grouped as follows :—

- I. Dorsal fin long; anal fin short. Carp, Crucian Carp.
- II. Dorsal fin short; anal fin short. Barbel, Gudgeon, Tench, Minnow, Chub, Dace, Roach, Rudd.
- III. Dorsal fin short; anal fin long. Bream, White Bream, Bleak.

37. 38. Carp, *Cyprinus carpio*.—The long dorsal fin and the presence of two barbels on each side of the mouth distinguish this species, which is a native of China and not indigenous to Britain. In this country it attains a weight of about 25 lbs., but it is said to grow much larger on the Continent.

Of the two specimens exhibited the larger (38) belongs to the variety known as "Mirror Carp," or "King Carp," which has the scales enlarged but reduced in number, part of the body being naked. This fish, weighing 20 lbs. 8 oz., was caught in the lake at Aldermaston, Herts, in December, 1911, and was presented by C. E. Keyser, Esq. The smaller fish shown (37) was taken from a pond in Kew Gardens in June, 1906; weight, 12 lbs. 8 oz.; presented by the Director, Royal Botanic Gardens, Kew.

39. Crucian Carp, *Carassius carassius* (fig. 16).—This species is placed in a genus distinguished from that of the Common Carp by the absence of barbels and by the very different pharyngeal dentition. It inhabits Europe, Turkestan, Siberia and Mongolia: in Britain it is rare, except in the Thames and some of the eastern

counties of England, and it may not be indigenous. It is said to attain a weight of 7 lbs., but the fish exhibited, 3 lbs. 12 oz., is believed to be the largest caught in this country by an angler; it

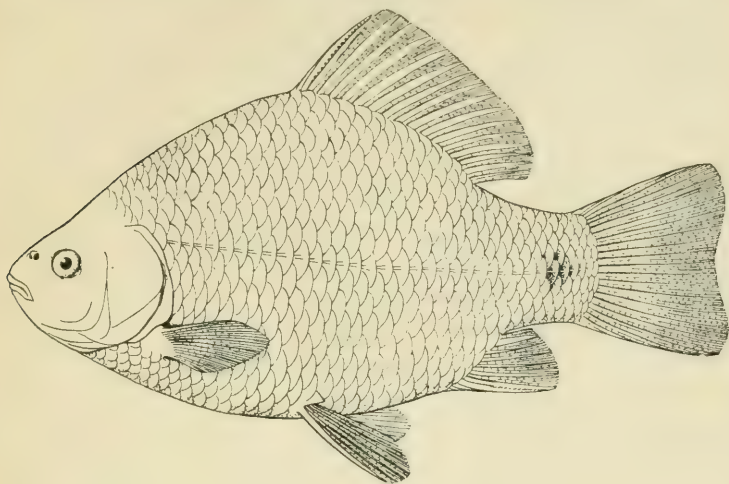


FIG. 16.—CRUCIAN CARP.

was taken in Cheshunt Reservoir in September, 1915, by the donor, J. Andrews, Esq.

The Gold-fish, *Carassius auratus*, is closely related to the Crucian Carp. It is a native of Eastern Asia, but has been introduced into almost every part of the world.

40. Barbel, *Barbus barbus*.—The Barbel is distinguished by the inferior horse-shoe-shaped mouth, with thick lips and with two barbels on each side, and by the strong serrated spine of the dorsal fin. It ranges from France through Germany to the Danube, and in Britain seems to be restricted to the Thames, the Trent, and some of the Yorkshire rivers. In this country a length of 36 inches and a weight of 20 lbs. is the maximum recorded, but in the Danube a much larger size is reached. The exhibited specimen is 30 inches long, and probably weighed about 13 lbs. It was taken from the Serpentine Lake in Hyde Park in 1844.

41. Gudgeon, *Gobio gobio*.—The Gudgeon is very similar to the Barbel, but the dorsal fin has no spine and the mouth has only one pair of barbels. It is found all over Europe, except the Iberian Peninsula and Greece, and extends through Northern Asia

to Mongolia. It is common in England, except Cornwall and the Lake District, and in Wales and Ireland, but it is absent from Scotland. The shoals frequent quiet shallows with a sandy or gravelly bottom. This is a small species, rarely growing to a length of 8 inches. The example exhibited, from the Thames, was mounted and presented by F. Page, Esq.

42. Tench, *Tinca tinca*.—The small scales, rounded fins and greenish colour are characteristic of this species, which is quite unlike any of the other British Cyprinoids. It inhabits Europe, Asia Minor and Western Siberia; in our islands it is generally distributed, except in Scotland north of Loch Lomond. It is a sluggish fish, found in lakes, ponds and slow-running rivers. There is a British record of a specimen weighing 11 lbs. 9 oz., but the angler does not often capture a larger Tench than the one exhibited, a fish of 5 lbs., which was taken in the lake at Gatton Park, Surrey, in June, 1915, by the donor, F. R. Graham, Esq.

43. Minnow, *Phoxinus phoxinus* (fig. 17). The Minnow is in most respects a miniature Chub or Dace, but the scales are much smaller than in those species. It inhabits Europe, except the Iberian Peninsula, and extends through Russian Turkestan and Siberia; it is generally distributed in England and Wales, is



FIG. 17.—MINNOW.

absent from the northern Highlands of Scotland, and is local in Ireland; 3 or 4 inches is the usual size, but examples 6 or 7 inches long have been taken. The pretty little fishes exhibited, showing the difference in coloration of the sexes in the breeding season, were mounted and presented by F. Page, Esq.

44. Chub, *Leuciscus cephalus* (fig. 18).—The Barbel and Gudgeon have barbels, the Tench and Minnow have small scales; in the remaining species with both dorsal and anal fin short the

mouth is terminal, without barbels, and the scales are relatively large. Of these the Chub is distinguished from the Dace, Roach and Rudd by its large head and wide mouth, but especially by having the margin of the anal fin convex instead of concave. The Chub ranges from Europe through Asia Minor to Persia; in the British Isles it is absent from Ireland, Scotland north of the Forth, and Devon and Cornwall. It is a river fish and likes swift

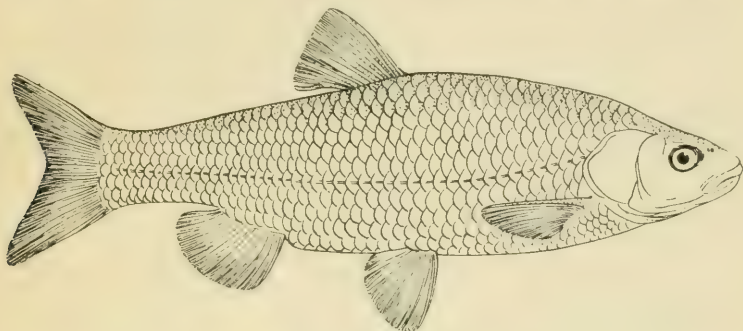


FIG. 18.—CHUB.

shallows; the larger ones often eat minnows and other small fishes. A length of 24 inches and a weight of 8 lbs. appears to be the maximum size for this country, but Continental specimens of 12 lbs. have been recorded. The fish exhibited, 6 lbs. 5 oz., was taken from the Avon at Christchurch on March 14, 1906, by the donor, E. J. Walker, Esq.

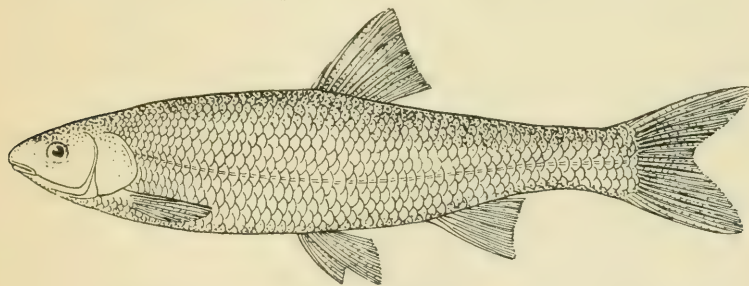


FIG. 19.—DACE.

45. Dace, *Leuciscus leuciscus* (fig. 19).—The Dace is a graceful and silvery fish; it is distinguished from the Chub by the concave edge of the anal fin. The dorsal fin, of 3 simple and 7 or 8 branched rays, originates above the base of the pelvic fins. The

Dace is found in Europe north of the Pyrenees and Alps, and ranges throughout Siberia; it inhabits most rivers of England and Wales, but is absent from Scotland and Ireland. Dace of $1\frac{1}{2}$ lbs. have been recorded, but the specimen exhibited, 1 lb. 4 oz., is exceptionally large; it was taken from the Kennet at Kintbury in September, 1916, and was presented by Frank Barker, Esq.

46. Roach, *Rutilus rutilus* (fig. 20).—Although so similar to the Chub and Dace in appearance, the Roach is now placed in a distinct genus because it has only one series of pharyngeal teeth instead of two. It is usually deeper in form than the Dace; the rather large dorsal fin, of 3 simple and 9 to 11 branched rays, originates above the end of the base of the pelvic fins. The Roach

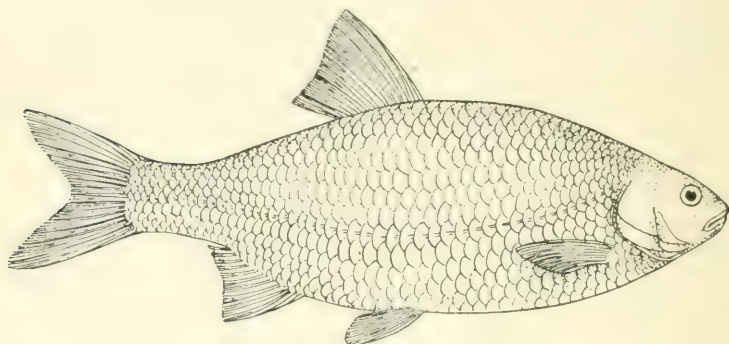


FIG. 20.—ROACH.

is found in Europe north of the Pyrenees and Alps, and in Russian Turkestan and Siberia. In Britain it ranges north to Loch Lomond and the Teith; it is absent from Ireland. The record English Roach, 3 lbs. $10\frac{1}{2}$ oz., was taken from the Bristol Water Company's reservoir in November, 1904. The example exhibited, a fine fish weighing 2 lbs. 8 oz., was taken in Hornsea Mere in January, 1915, by the donor, E. Kempsey, Esq.

47. Rudd, *Scardinius erythrophthalmus* (fig. 21).—Biserial pharyngeal teeth with pectinated edges characterize the genus *Scardinius*. The Rudd is a deep-bodied fish, with a bronze or golden tinge on the sides and with reddish fins; the dorsal fin is smaller and farther back than in the Roach, originating well behind the base of the pelvic fins. The Rudd occurs in Europe (except the Iberian Peninsula), Asia Minor, Russian Turkestan

and Siberia; in England it is common in the eastern counties, but is local elsewhere; it is absent from Scotland, but is abundant in Ireland. It is especially a fish of lakes, ponds and slow-running

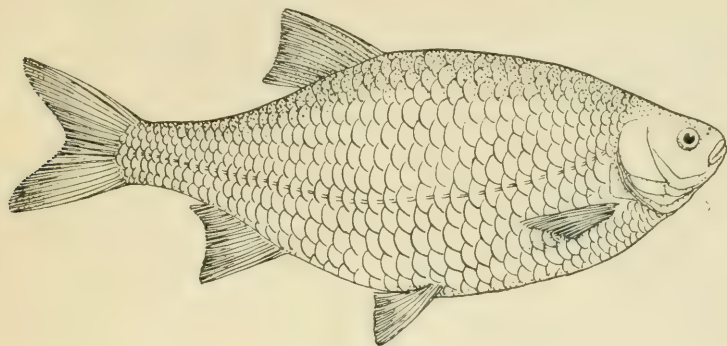


FIG. 21.—RUDD.

rivers. A length of 18 inches and a weight of $3\frac{1}{2}$ lbs. may be reached. A Rudd of about $2\frac{1}{2}$ lbs. is exhibited; it is from Norfolk, and was presented by J. G. Buxton, Esq.

48. Hybrid Roach and Rudd, *Rutilus rutilus* × *Scardinius erythrophthalmus*. This hybrid is probably not uncommon in most localities inhabited by the parent species, but may generally be mistaken for one or the other of them. It is in every way intermediate between the parents, and this may particularly be noted in regard to the position, size and form of the dorsal fin. The very fine specimen shown, weighing 3 lbs., was taken from a pond near Doncaster in August, 1915, by the donor, W. E. Park, Esq.

49. Silver Bream or White Bream, *Blicca bjoerkna*.—This species has a deep, strongly compressed body, a long anal fin, of 2 or 3 simple and 19 to 24 branched rays, and rather large scales, there being 8 to 11 in a transverse series from dorsal fin to lateral line; the coloration is silvery white, with greyish fins. The Silver Bream ranges throughout Europe north of the Pyrenees and the Alps into Western Siberia. In this country it is found in east coast streams from Yorkshire to Suffolk, occurring only in slow-running rivers or in lakes. It attains a length of about 12 inches and a weight of $1\frac{1}{4}$ lbs. The example shown is from the Cam.

50. Common Bream or Carp Bream, *Abramis brama* (fig. 22). In this species the pharyngeal teeth are uniserial, whereas in the White Bream they are biserial (cf. p. 23). The branched rays of the anal fin number 23 to 29, the scales from dorsal fin to lateral line 11 to 15; the coloration is brownish or greenish, with bronze reflections; the fins are blackish. The young are silvery, and are generally confounded with the Silver Bream, and with Bream hybrids with Rudd and Roach, under the name Bream-flat. The Common Bream inhabits Europe north of the Pyrenees and Alps, Russian Turkestan and Western Siberia; in Britain it is absent from Scotland north of the Forth, and from the north-western counties of England; in

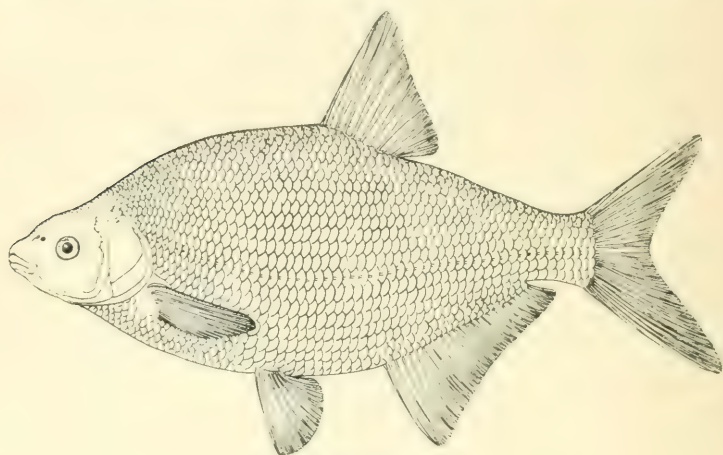


FIG. 22.—COMMON BREAM.

Ireland it is common. It is found in lakes and sluggish rivers. There is a record of a 17-lb. Bream from the Trent. The specimen shown, weighing 7 lbs. 14½ oz., was caught in the River Wensum, near Norwich, in December, 1915, by Mr. W. G. Hewitt. A Bream of 8 lbs. 8 oz., a female distended with eggs, is exhibited in the Fish Gallery (Case 8, No. 349).

51, 52. Bream Hybrids.—The Common Bream and the White Bream are known to form a hybrid, but it does not seem to have been recognized in this country. Moreover, both species hybridize with the Roach and the Rudd, and in some years the hybrids between these species and the Common Bream may be

quite abundant in certain localities. These hybrids are in every way intermediate between the parent species.

The hybrid Bream and Roach (*Abramis brama* × *Rutilus rutilus*) has the form of a deep Roach; the anal fin is rather long, and has 15 to 19 branched rays. A very fine example of this hybrid (51), weighing 3 lbs. 10 ozs., is exhibited; it is from a lake at Tortworth, Gloucestershire, and was presented in 1914 by the Earl of Ducie, F.R.S.

The hybrid Bream and Rudd (*Abramis brama* × *Scardinius erythrophthalmus*) differs from the Bream and Roach hybrid in the same characters that the Rudd differs from the Roach—body usually a little deeper, mouth more oblique, dorsal fin a little farther back, etc. This fish is well known to the Lough Erne fishermen, who call it “White Roach.” One of a series from Lough Erne presented by the late Major H. Trevelyan is exhibited (52); the largest of these weighed 2 lbs.

53. Bleak, *Alburnus lucidus*.—This pretty and lively little fish shows more resemblance to the Dace than to the Breams in its elongate form and bright silvery coloration; its relationship is really with the Breams, as is shown by the rather long anal fin and the sharp edge of the abdomen in front of it. A silvery powder extracted from the scales of the Bleak is used in France in the manufacture of artificial pearls. The Bleak inhabits Europe north of the Pyrenees and Alps; in Britain it is absent from Scotland, the Lake District, and the counties bordering the Channel; it does not occur in Ireland. It grows to a length of 8 inches. The specimen exhibited, from Weybridge, was presented by F. Page, Esq., in 1915.

54. 55. Bleak Hybrids.—The Bleak is known to form hybrids with the Dace, Chub, Roach, Rudd and White Bream. The commonest of these is the hybrid Bleak and Chub (*Alburnus lucidus* × *Leuciscus cephalus*), which is represented in the Museum by specimens from the Mole, the Thames, and from a reservoir near Oundle; a model of one from the first-named locality is shown (54). This hybrid combines the physiognomy of both parents; the anal fin has 10 to 13 branched rays. The other Bleak hybrids are rare; of the two examples known of the Bleak and Roach hybrid (*Alburnus lucidus* × *Rutilus rutilus*) one was taken in the River Nen in 1889. A model of this is exhibited (55); it has a deeper body than the hybrid Bleak and Chub.

COBITIDAE.

The Loaches are closely related to the Cyprinidae, but they have no plate for the pharyngeal teeth to bite against. Externally they are distinguished by the elongate body, with the scales very small or absent, and by the presence of at least six barbels. The majority of the species inhabit mountain streams of Central and Southern Asia; two of the three European species occur in our islands.

56. Loach or Stone Loach, *Nemachilus barbatulus*.—The Loach has the body spotted or marbled, and the fins crossed by series of small spots. It inhabits Europe, except the Iberian Peninsula and Greece, and ranges through Turkestan and Siberia to China and Japan; in the British Isles it is widely distributed, but is absent from the Highlands of Scotland. Loach frequent small streams, and lie concealed beneath stones during the day; they are said to be more active at night. A length of about 5 inches may be reached.

57. Spined Loach, *Cobitis taenia*.—This species takes its name from the erectile spine that lies in a groove below the eye; the most conspicuous feature of its coloration is the interrupted dark lateral stripe or series of spots. Its general distribution is the same as that of the Stone Loach, but in our islands it has been recorded only from a few localities in England. It often buries itself in the sand, and lies with the head protruding. It may grow to about 4 inches long.

GADIDAE.

The Cod family includes fishes with all the fin-rays flexible and jointed, but with the pelvic fins placed in advance of the pectorals.

58. Burbot, *Lota lota*.—This is the only fresh-water fish of the family. The head is broad and the mouth wide, with bands of pointed teeth; the lower jaw has a barbel; the dorsal fin is divided into a short anterior and a long posterior part, the latter opposed to the anal and continuous with the rounded caudal; the body is spotted or marbled with brown or black. The Burbot is found in Europe, except the Iberian Peninsula and Greece; it extends through Siberia to Alaska and the Great Lakes of North

America; in Britain it inhabits eastern rivers from Durham to Suffolk. Like the Eel it lurks in the day-time and at night goes in pursuit of its prey. The breeding season is from January to March. A specimen of 8 lbs. has been recorded from the Trent; on the Continent twice that weight is reached, and in Alaska the Burbot attains 60 lbs.

PERCIDAE.

The Percidae are fresh-water fishes of North America, Europe and Northern Asia. They have two dorsal fins, the anterior long and with the rays represented by strong sharply pointed spines; the pelvic fins are placed below the pectorals; the mouth is toothed, protractile, with the maxillaries excluded from the oral border (fig. 1A, p. 8).

59. Perch, *Perca fluviatilis*.—The Perch is a handsome fish, at once distinguished by the dark bars on the sides. It inhabits Europe, except the Iberian Peninsula; extends through Transcaspia

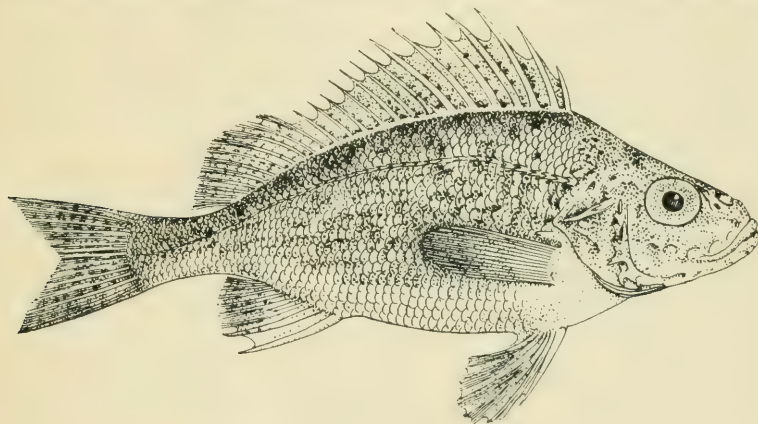


FIG. 23.—RUFFE.

and Siberia, and is represented in Turkestan and in North America by very similar species. In our islands it is common everywhere, except in the north of Scotland, but it is not found in swift-running streams. The shoals of Perch rove in search of little fishes, worms, insect larvae, shellfish, etc., on which they feed. They breed on reedy shallows from March to May. A weight of 5 lbs. is seldom exceeded, but a Perch of 8 lbs. is said to have been taken from the Avon, and one of 10 lbs. from Bala Lake.

The fish exhibited was captured in the Kennet at Newbury by the donor, A. P. Zeffass, Esq.; weight, 2 lbs. 12 oz.

60. Ruffe or Pope, *Acerina cernua* (fig. 23).—In this species the dorsal fins are united, and it differs from the Perch in several other characters, including the spotted or marbled coloration. It inhabits Europe north of the Pyrenees and Alps, Russian Tarkestan and Siberia; in our islands it is absent from Scotland and Ireland, and in England and Wales from the counties north of Lancashire and Yorkshire and from the south-western counties. It is a small fish, reaching a length of 8 inches. The shoals keep near the bottom in quiet waters, and do not roam about so actively as the Perch.

SERRANIDAE.

The Sea Perches differ from the Perch family in that the anal fin is preceded by three spines instead of two. The majority are marine, but some species ascend rivers.

Bass, *Morone labrax*.—The Bass is distinguished from the Perch by the silvery coloration. In the summer months this fish may ascend some of our southern rivers for considerable distances, but these occasional incursions hardly give it a place among our fresh-water fishes. One is exhibited in the Fish Gallery (Case 13, No. 511).

MUGILIDAE.

In the Grey Mulletts the spinous dorsal fin is formed of only four sharp spines and is widely separated from the soft dorsal; the mouth is small and the teeth are minute. There are three British species, the **Thick-lipped Grey Mullet** (*Mugil chebo*), the **Golden Grey Mullet** (*M. auratus*), and the **Thin-lipped Grey Mullet** (*M. capito*). These marine fishes frequent estuaries, and at times ascend beyond tidal limits. An example of *Mugil capito* is shown in the Fish Gallery (Case 11, No. 457).

COTTIDAE.

This family includes a large number of marine species, mostly from northern seas, and a comparatively small number of fresh-water species from Europe, Northern Asia and North America.

61. Bullhead or Miller's Thumb (*Cottus gobio*).—This little fish has a scaleless body and a broad head, from each side of

which a rather strong spine projects; its coloration is olive spotted, marbled or barred with brown or black. It is found all over Europe, except the Iberian Peninsula and Greece; in our islands it seems to be absent from Scotland and Ireland. It lurks on the bottom or under stones, waiting for the small fishes, worms, etc., on which it feeds. In March or April the Bullheads pair and scoop out a hole under a stone, forming a nest; the eggs are adherent, and are usually attached to the under side of this stone; the male guards the nest until the fry swim away. The usual length of this species is 3 or 4 inches; exceptionally 6 inches may be attained. The exhibited specimen is from a brook at Selborne, and was presented by Dr. R. Bowdler Sharpe.

GASTROSTEIDAE.

The Gastrosteidae are a northern family; they are distinguished from other fishes found in our rivers in having the spines of the spinous dorsal fin free, unconnected by membrane.

62, 63. Three-spined Stickleback, *Gastrosteus aculeatus*.—This little fish is never more than 4 inches long; its dorsal fin has three (rarely two or four) spines. It is found on the coasts and in the rivers of arctic and north temperate countries; in the arctic regions it is principally marine, and in Southern Europe it appears to be strictly a fresh-water fish. The development of a lateral series of bony plates is very variable, but as a rule the series is complete in marine Sticklebacks and is reduced to 3 or 4 anterior plates in those from inland localities. The Three-spined Stickleback is famous for its boldness, greediness and pugnacity. In the spring or summer the male fish acquires a brilliant red colour on the belly and builds a nest, a dome or barrel-shaped structure made of bits of the roots and stalks of water-weeds cemented together by a secretion from his kidneys; when the nest is made he seeks a mate, often fighting to win her, and after the eggs are laid he guards the nest until the young fish desert it. The model exhibited (62) is the work of the donor, F. Page, Esq. A male in breeding dress is also shown (63).

64. Ten-spined Stickleback, *Pygosteus pungitius*.—The spinous dorsal fin is represented by a series of about ten small spines, alternately divergent to the right and left; the body is naked except for a few small plates bearing a keel on each side of the tail; the maximum length is 3 inches. This is a northern species, and in Europe does not cross the Alps; it varies in

different parts of its range: the form that inhabits the British Islands and France is distinguished from that of Northern Europe by its shorter spines. In habits this species differs from the Three-spined Stickleback in that the nest is not built on the bottom, but is attached to weeds or grasses.

PLEURONECTIDÆ.

The Flat-fishes lie on one side; both eyes are on the upper side, which is coloured, whilst the lower side is white. Most of the Flat-fishes are marine, but some enter fresh water.

65. Flounder, *Pleuronectes flesus*.—The Flounder is closely related to the Plaice; it is common on all the coasts of Europe, and ascends rivers as far as the first falls. It is remarkable for its power of changing its coloration to resemble the ground on which it lies. It feeds especially on small shellfish, but also eats worms, little fishes, etc. It grows to a length of about 18 inches.

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